Organometallic Lanthanide Single-Ion Magnets on Surfaces

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Single-ion magnets (SIMs) are molecular complexes containing only a single transition metal or lanthanide ion, which exhibit magnetic hysteresis of purely molecular origin without the need of long-range magnetic order [1,2]. Organometallic lanthanide SIMs are a special class of these materials. In recent years, this field has seen much activity with the most prominent member being the record-breaking, high-blocking-temperature dysprosocenium SIM [3,4].

In this work we study two different sandwich-type erbium-based SIMs built from the anionic ligands cyclooctatetraenide (COT^{2-}) and pentamethyl-cyclopentadienide (Cp^{*-}), namely Cp*ErCOT [5] and $[K(18\text{-crown-6})]^+$ $[Er(COT)_2]^-$ [6]. Our experiments on submonolayers of these SIMs on the Ag(100) surface using XPS, STM and polarized X-ray absorption spectroscopy reveal that despite their structural similarity they organize very differently on the surface. Furthermore, they exhibit entirely different magnetic anisotropies and hysteresis openings (*cf*. Fig. 1). The relationship between the magnetic, structural and adsorption properties will be discussed.

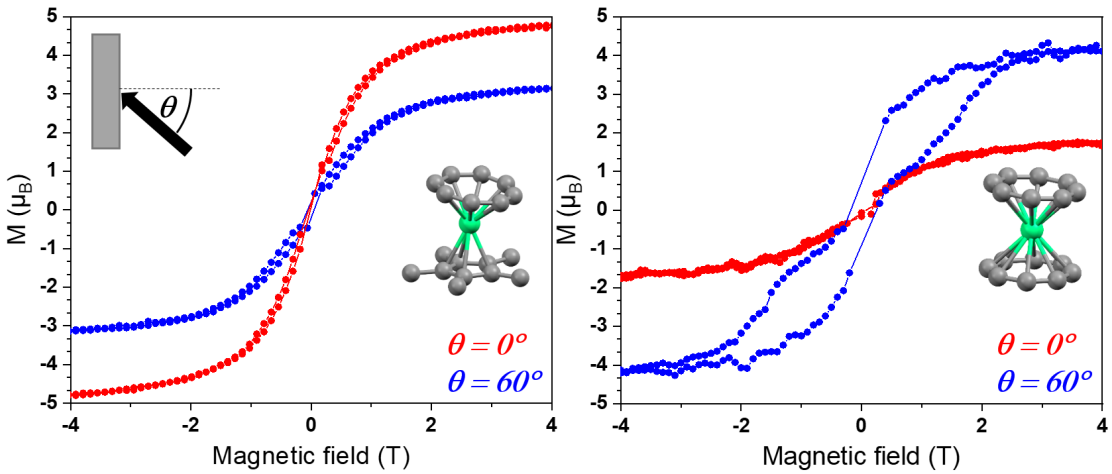

Fig. 1. Magnetic hysteresis loops recorded at T = 3 K on 0.5 monolayers of (left) Cp*ErCOT and (right) $Er(COT)_2$. The inset scheme depicts the experimental geometry with the black arrow denoting the incident X-ray beam. In the molecular ball-and-stick images hydrogen and the potassium crown ether counter ion are omitted (color code: grey: carbon; turquoise: erbium). The magnetic anisotropy and the hysteresis opening are entirely different despite the structural similarity of both SMMs.

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